growing fresh water fish in India. For record growth they must be reared in weedy ponds with abundant fresh water snails; the water, as stated above, must remain absolutely fresh throughout the year for best results. Being a rapid grower it is specially recommended for ponds or wells which do not hold a perennial supply of water. From experiments it is found that young fish measuring ½ inch to 1 inch attains on an average a length of 1 foot in 6 months and 18 inches to 2 feet in the first year in ponds and wells. In large reservoirs with perennial water, it attains 3 feet to 3½ feet in length and 30 to 40 lb. in weight in 2½ to 3 years.

NOTE ON FRESH WATER FISHES OF BOMBAY AND SALSETTE ISLANDS[1]

BY

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(1 *photo and* 4 *text-figures*)

Scarcely any account exists at present of the fresh water fish fauna either of Bombay or of its adjoining island on the north-west, known as Salsette. Even the official gazetteer for this area (Thana District) contains no record of the fresh water fish life of the islands of either Bombay or Salsette. Day, in his *Fishes of India*, refers to Bombay as the habitat of only a small number of fresh water species but no record is available of the presence in or round about Bombay of some of the fishes which are stated by him to occur there. Fowler's 'Notes on Fishes from Bombay'[2] describe only the marine forms, whereas Spence and Prater in 'Game Fishes of Bombay Presidency, etc.',[3] deal only with such fresh water forms as are suitable for angling. Scientific investigators desirous of knowing the entire fish fauna of this area for either commercial or study purposes, are thus often disappointed.

Further, it is necessary to record some of the important varieties which have been introduced from outside in this area and which, although exotic, now form a part of the local fish fauna. Such a record is undoubtedly essential to understand the natural distribution

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[1] I am grateful to Dr. S. B. Setna, Director of Fisheries, Bombay, for his constant encouragement and guidance in the compilation of this paper.

[2] *J.B.N.H.S.*, 31, (1926), pp. 770-79 and Vol. 32 (1927), pp. 251-63.

[3] *J.B.N.H.S.*, Vol. 36 (1932), pp. 29-66.

of fish in this locality. The purpose of the present paper is therefore, to furnish an up-to-date list of the fresh water fish occurring around Bombay and to provide a short account of the varieties introduced from outside.

The geographical position of Bombay and Salsette is sufficiently well known to need further description. Salsette Island, which was formerly apart from Bombay, is now connected with the island of Bombay by causeways and the two are now separated from the mainland of India only by the Bassein creek in the north and the Thana creek in the east, both creeks being formed by the bifurcation of Ulhas river to join the Arabian Sea. In the north eastern part of Salsette lies a range of small hills where are situated the sources of such small streams as Borivli (Dahisar nala) and Vehar (Gopar river) nalas flowing towards the west and south respectively.

Till the middle of the last century Salsette Island had very few perennial reservoirs except scattered ponds in villages and pools in the beds of the two aforesaid streams. The completion of the Bombay Municipality's water schemes resulted in the formation of the Vehar lake in 1858 and the Tulsi lake in 1879 the nucleus of the water in the catchment areas being furnished by the impounding of the aforesaid streams.

The Powai lake was completed in 1891 and a smaller lake named Pokharan, near Thana, was completed in 1880. These lakes form, therefore, the main habitat of whatever fresh water fish is available around Bombay. The overflow from Vehar and Powai pours into the bed of the Vehar nala and thus distributes the aquatic life of the lakes to places outside the catchment regions, finally discharging into the sea through the Mahim creek. The water below the Tulsi lake, winding its way at the foot of the hills containing the Kanheri caves and gathering additional volume from streams in other hills, forms the Borivli stream, which running via Borivli and Dahisar empties itself into the Arabian Sea.

The Vehar and Tulsi lakes are reserved for the supply of drinking water to the city of Bombay and the Pokharan lake to the town of Thana. Water from the Powai lake having been pronounced undrinkable is stagnant throughout the year and the lake is partially open for fishing. The volume of water in the Borivli and Vehar nalas, including a few scattered tanks, is not perennial. Thus, only the Powai lake is the sole habitat of fresh water fish life in this area.

The Powai lake, which is about 17 miles to the north-east of Bombay, was constructed out of a small valley by the erection of a masonry dam across two hillocks. It is approximately 370 acres in area. The banks of the lake are covered with jungle vegetation, and its bed is made up of loamy soil and interspersed with a few rocks and old submerged stems of trees. During the monsoon, the volume of water increases considerably, the lake being fed by small streams rushing down the adjoining hill region extending over about 17,000 acres. The maximum depth of the lake is about 40 ft. The annual rainfall in the region of the lake is about 100 inches, and the lake overflows for about 60 to 70 days during the monsoon.

Fish of Powai Lake.—A vital factor to be borne in mind in the compilation of a list of the fishes in the Powai area and the adjacent

Three year growth of Catla (extreme left in hand) and Rohu (remaining three) fattened in the Bandra pond.

region is that all of them are not indigenous. The Fisheries Department of the Province has introduced into the lake, at the request of the Bombay Presidency Angling Association, several varieties, including estuarine fish as well as exotic fresh water forms. The indigenous fish recorded from the lake are as follows :—

	Scientific name.		*Local name.*
[1] 1.	*Barbus* (*Puntius*) *sarana* (Ham.)	...	Khaul Masa.
=	*Barbus* (*Puntius chrysopoma* (C. V.)	...	Sava masa.
2.	,, ,, *amphibius* (Cuv. V.)	...	Khiret.
3.	,, ,, *vittatus* Day		
4.	*Labeo ariza* (Buch)	...	Kavdasha.
5.	*Rasbora daniconius* (Ham.)	...	Kadavali or Dandavan.
6.	*Danio malabaricus* (Jerdon)	...	Pidatoli.
7.	*Chela clupeoides* (Bloch.)	...	Salpe.
8.	*Garra mullya* (Sykes)	...	Mulya.
9.	*Heteropneustes fossilis* (Bloch-)	...	Narshingali.
10.	*Mystus gulio* (Ham.)	...	Shingali or Shingati.
11.	,, *cavasius* (Ham.)	...	Shingali.
12.	*Nemachilus botia* (Nom.)	...	Murra or Muri.
13.	*Lepidocephalichthys thermalis* (C. V.)	...	,, ,,
14.	*Aplocheilus lineatus* (C. V.)	...	Piku or Taragya.
15.	*Macropadus cupanus* (C. V.)	..	Choti Khajuri.
16.	*Anabas testudineus* (Bloch.)	...	Khajuri.
17.	*Glossogobius giuris* (Ham.)	...	Kharba.
18.	*Ophiocephalus gachua* (Ham.)	...	Dhok.
19.	*Mastacembalus armatus* (Lacip.)	...	Wam.
20.	*Megalops cyprinoides* (Brouss.)	...	Washi or Wadas.
21.	*Lates calcarifer* (Bloch.)	...	Khajari, Jitada, Khajuri.

Fingerlings of *Megalops cyprinoides* and *Lates calcarifer*, both of which are local estuarine fish, have been introduced mainly to meet anglers' needs but they are not expected to breed in the lake. The bulk of the other recorded specimens are of small size, and are thus of minor commercial importance.

The largest indigenous fishes in the lake, viz. *Barbus sarana* or the Common Olive Carp and the fresh water Gobi, *Glossogobius giuris* rarely exceed 10 in. to 12 in.[2] in length and are the only forms worthwhile commercially.

Glossogobius giuris breeds freely in the weeds along the borders of the lake, whereas *B. sarana* migrates into the adjoining small streams to spawn during floods in the early stages of the monsoon. Precisely at this time when the fish must be spared, great numbers of them are trapped by fishermen and villagers of the neighbouring areas. The only redeeming feature of this indiscriminate method of capture is that the fish are generally caught not when they are moving up stream but when they are returning from their spawning grounds after discharge of their reproductory products.

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[1] Dr. Hora (*J. B. N. H. S.*, Vol. 43, p. 225) considers *B. sarana* and *B. chrysopoma* as synonymous.

[2] Spence and Prater (*J.B.N.H.S.*, Vol. 136, p. 48) record. *B. chrysopoma* as attaining 2 ft. 9 in. This is probably a mistake if *B. sarana* and *B. chrysopoma* are synonymous. Besides, the colour of the fins on the body of the fish should be olive grey and not orange red as depicted by the authors.

The extent of such protection, apart from being fortuitous, is rather precarious as occasions may arise when floods are of brief duration and the fish which go upstream have to come downstream

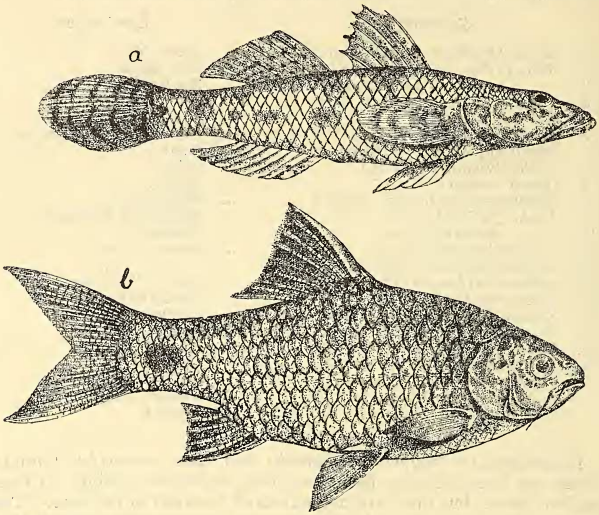

Fig. 1 (*a*) *Glossogobius giuris* (Ham.) ; (*b*) *Barbus* (*Puntius*) *sarana* (Ham.)

immediately, and are thus captured before they are able to deposit their eggs.

The exotic fishes introduced into the lake are as follows:—

1. Catla [*Catla catla* (Ham.)]
2. Rohu [*Labeo rohita* (Ham.)]
3. Mirgal [*Cirrhina mrigala* (Ham.)]
4. Calbasu [*Labeo calbasu* (Ham.)]
5. Gourami [*Osphronemus goramy* (Lacep.)]

Fry of the first four carps were specially imported from Patna and released in the lake after they had been fattened in a small pond. The object of their introduction was to determine whether these important food fishes, which generally breed in large rivers, would breed in the temporary streams which flow into the lake during the monsoon.

Fish of Vehar and Borivli Streams.—The fishes in these streams are, evidently, the same as the indigenous fish in the Powai lake mentioned above. *H. fossilis, O. gachua, A. testudineus* and *B. vitattus*, which favour the still waters of ponds, are not common in

streams. On the other hand, *N. botia*, *Lepidocephalichthys thermalis*, *Danio malabaricus* and *G. mullya*, which are rare in the lakes, are common in the streams, the difference being due apparently to the different ecological conditions required by these fish.

Wallagonia attu, which does not occur in the Vehar stream, figures but occasionally in the lower reaches of the Borivli stream below the dam near the Borivli railway lines, having migrated there from the Ulhas river through the Bassein creek and other small interconnecting channels during excessive floods.

Through the lower reaches of the two streams innumerable fingerlings of *Megalops* migrate into fresh water puddles during the monsoon and are thus often stranded there after the rainy season. Fingerlings of *Chanos* and *Elops* migrate similarly, but they are comparatively fewer in numbers. Fingerlings of *Lates*, *Mugil*, *Eleotris* and *Awaous* migrate upstream as long as there is a tolerable admixture of salt and fresh water. The streams thus contain the following fish in addition to those mentioned as occurring in the Powai lake :—

1. *Chanos chanos* (Forsk.).
2. *Elops saurus* Linn.
3. *Mystus malabaricus* (Jerdon).
4. *Eleotris fusca* (B. Schn.).
5. *Awaous stamiuens* (Val.).
6. *Wallagonia attu* (B. Schn.).
7. *Mugil tade* (Forsk.).

There are several natural ponds in the suburban area, but, as stated at the outset, very few of them are perennial to enable the life they contain to thrive. Improvement of living conditions in the suburban district and the provision of a regular supply of tap water by the municipalities have led to the disuse of such natural ponds as existed. They are becoming increasingly silted every year. During the monsoon, fingerlings of most of the fish mentioned above, instinctively migrate into these tanks from streams below the lakes and inhabit them temporarily. All this fish life is fished out by village urchins during the hot weather before the ponds are completely dry. Deeper tanks afford protection to the fish for a slightly longer time but the fate of these fish is not more assured owing to the uncertainty of water supply, which fails whenever the rainfall is scanty.

Exotic fish fauna.—Reference has already been made to the north Indian carps introduced into the Powai Lake. In addition to these, other useful varieties from outside have also been liberated in different sheets of water in the suburban district where they did not exist previously. They are now thoroughly acclimatised to their new habitat, and may appear to a lay observer as indigenous forms unless told otherwise. A complete list of the exotic fishes occurring in the waters of the Bombay suburban district is as under :—

(1) *Catla catla* (Ham.).
(2) *Labeo rohita* (Ham.).
(3) *Cirrhina mrigala* (Ham.).
(4) *Labeo calbasu* (Ham.).
(5) *Osphronemus goramy* (Lacep.).
(6) *Etroplus suratensis* (Bloch).
(7) *Etroplus maculatus* (Bloch).

(8) *Ophicephalus marulius* (Ham.).
(9) *Gambusia affinis* (Baird.).
(10) *Aplocheilus blochii* (Arnold).

The introduction into the Powai Lake of catla, rohu and mrigal got from Patna has been successful inasmuch as the fish have not only established themselves in the lake but also bred there. Experiments on fattening the fish in the Bandra and Kurla tanks have proved that on an average catla, rohu and mrigal grow to about 5 lb., 2 lb. and $\frac{3}{4}$ lb. in weight in the first ten months, although maximum weights in the same period of 8 lb., 3 lb. and $1\frac{3}{4}$ lb. respectively have also been recorded. Growth in the second year is more pronounced, catla growing to 8–10 lb., rohu to 6-9 lb. and mrigal to $2\frac{1}{2}$–3 lb. In contrast, the local carp *B. sarana* hardly grows to $1\frac{1}{2}$ lb. in two years. These figures clearly establish that catla and rohu are among the most rapidly growing fresh water fishes in India. This fact has, therefore, induced the Fisheries Department, Bombay, to undertake their stocking in our waters on as large a scale as possible, so that once they have bred in profusion, their fingerlings may be used to stock sheets of water elsewhere in the Province.

The aforesaid carps have thrived successfully in the Powai Lake. Specimens of rohu and catla weighing up to 42 and 60 lb. respectively have been recorded from the lake, and confirmatory evidence of rohu breeding in the lake has also been obtained in recent years. The breeding, however, has been on a small scale.

Gourami.—Gourami is now sufficiently well known as a valuable exotic food fish. Its natural habitat is Java whence it was imported

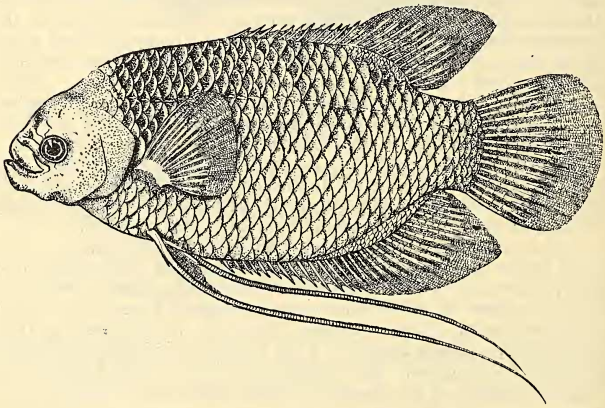

Fig 2. *Osphronemus goramy* (Lacep.).

into India. The fish was first brought to Bombay from Madras in 1937 as fingerlings, and since 1940 the fish has been breeding freely in the Bandra tank. Fingerlings of this fish have been introduced in Tulsi, Vehar and Powai lakes, where also they have bred in